

To facilitate the description of the flow regime, CSE established six transects based on the bathymetry data, which appear in Figure 5. To calculate the flow across each transect, the velocity across the transect is first estimated as

$$U_t = |\mathbf{u}| \text{sign}(\mathbf{u} \cdot \mathbf{f})$$

where

$\mathbf{u}$  = velocity vector

$\mathbf{f}$  = unit vector at right angles to the transect in the flood direction

The flow across the transect is then calculated as

$$Q = \int U_t ds$$

where

$s$  = distance from the beginning of the transect

The average velocity across the transect is equal  $Q / A$ , where  $A$  is the cross sectional area of the transect. During the flood cycle,  $U_t$  and  $Q$  are positive; during the ebb cycle,  $U_t$  and  $Q$  are negative.

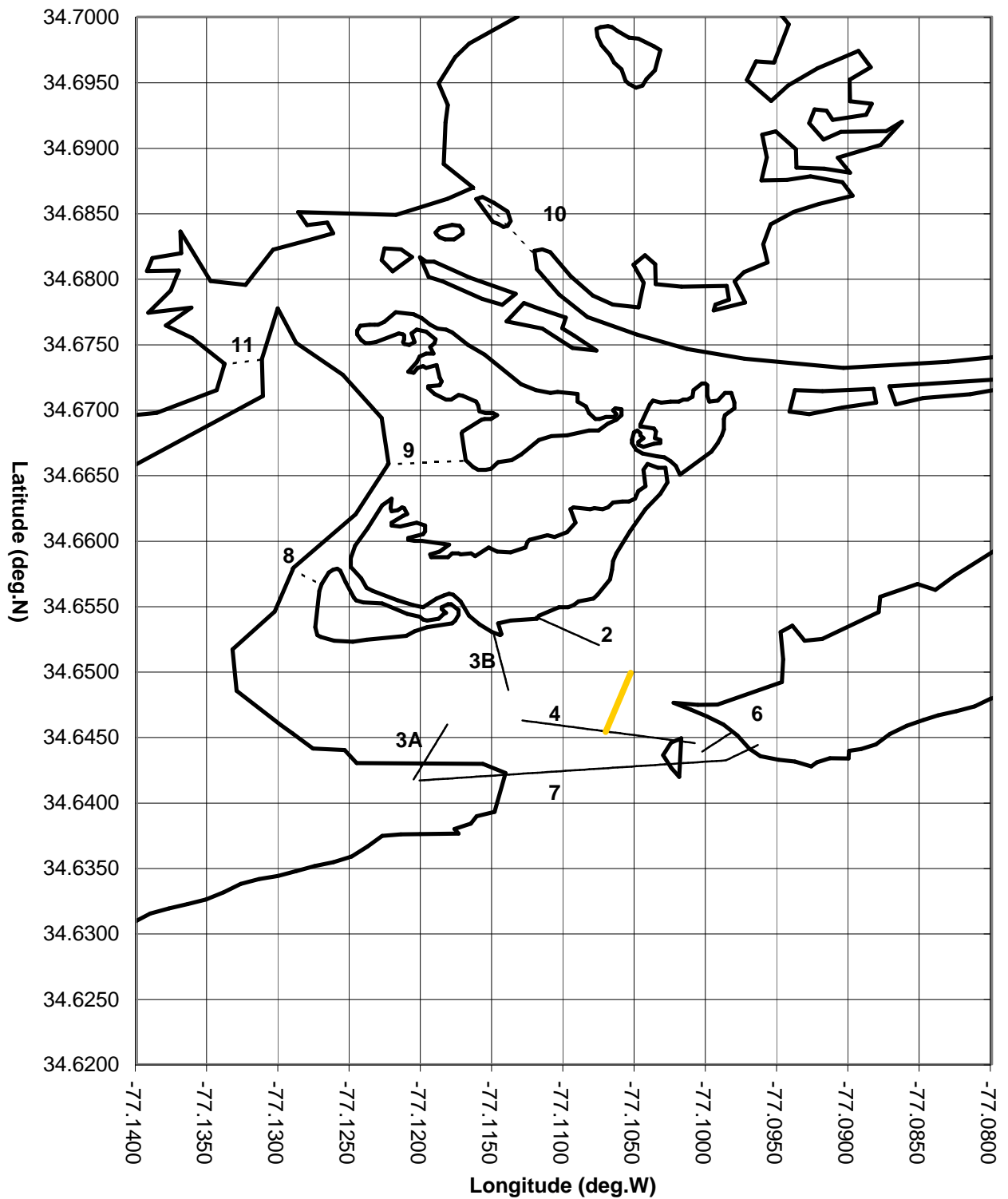
Velocities and discharges for the ten transects appear in Appendix B. Discharges for Transects 8 and 9 are omitted due to the lack of reliable bathymetry at these locations. Among the 10 transects in Figure 5, the most important are 2, 6, 7, and 8. Transect 7 crosses the mouth of Bogue Inlet, representing the tidal prism and combined flow into Bogue Inlet, the White Oak Basin, the Queen's Creek basin, and western Bogue Sound. Transect 6 represents the flow along Emerald Isle erosion hotspot. Transects 2 and 8 represent the flow around Dudley Island, which is a key fish and wildlife habitat.

The average modeled velocity across Transect 7 is on the order of 2 feet per second during peak flood and 2.5 feet per second during peak ebb. The corresponding discharges are roughly 40,000 cfs during peak flood and 30,000 cfs during peak ebb. The ebb flow is less than CSE's (2001) of 40,000 cfs. However, tidal prism estimates based on the ADCIRC results and CSE (2001) are similar, equal to 521,000,000 ft<sup>3</sup> and 535,000,000 ft<sup>3</sup>, respectively.

The average velocity across Transect 6 is near 2 feet per second during peak flood and 3 feet per second during peak ebb. The maximum velocities during peak flood and peak ebb are 2.9 and 5.2 feet per second, respectively. The high currents are the prime cause of the erosion at this location.

The average velocity at Transect 2 is near 2.5 feet per second during peak flood and 2 to 2.5 feet per second during peak ebb. The direction of the flood current varies from north

# TRANSECT LOCATIONS - BOGUE INLET, NC



— CSE (2001) Transects    - - - - CPE Transects    — ADCIRC Model Shorelines    — Closure Dike

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**TRANSECT LOCATIONS - BOGUE INLET, NC**

DATE: 12/3/2003

BY: C.DAY

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FIGURE NO. 5

to east-northeast. The northerly component of the velocity is responsible for the erosion along the south bank of Dudley Island. Along Transect 8, the corresponding velocities are 1 foot per second and 0.5 feet per second.

### **Improved Conditions**

Three improved conditions were modeled: a new channel dredged to -14 feet MLW (-15.6 feet NGVD), a new channel with a +6 feet NGVD dike to close the existing channel, and a new channel with the dike partially completed. The velocities and discharges associated the first two scenarios appear in Appendix B. Although several depths are under consideration for the new inlet channel, variations in the flow patterns with small changes in design depth are expected to be minor. Accordingly, no other design depths were simulated.

#### *-14 foot MLW Channel*

The peak flood and ebb flows given a new channel dredged to -14 feet MLW appear in Figure 6. The flow regime consists of a sheet flow across the mouth of the inlet, with heavy concentrations of flow in both the new channel and the existing channel. Because flow still occurs in the existing channel, simply dredging a new channel will not be sufficient to stop the erosion of Emerald Isle. Average velocities across Transect 6 are 0.3 feet per second lower than existing conditions during peak flood and 0.5 feet per second lower during peak ebb.

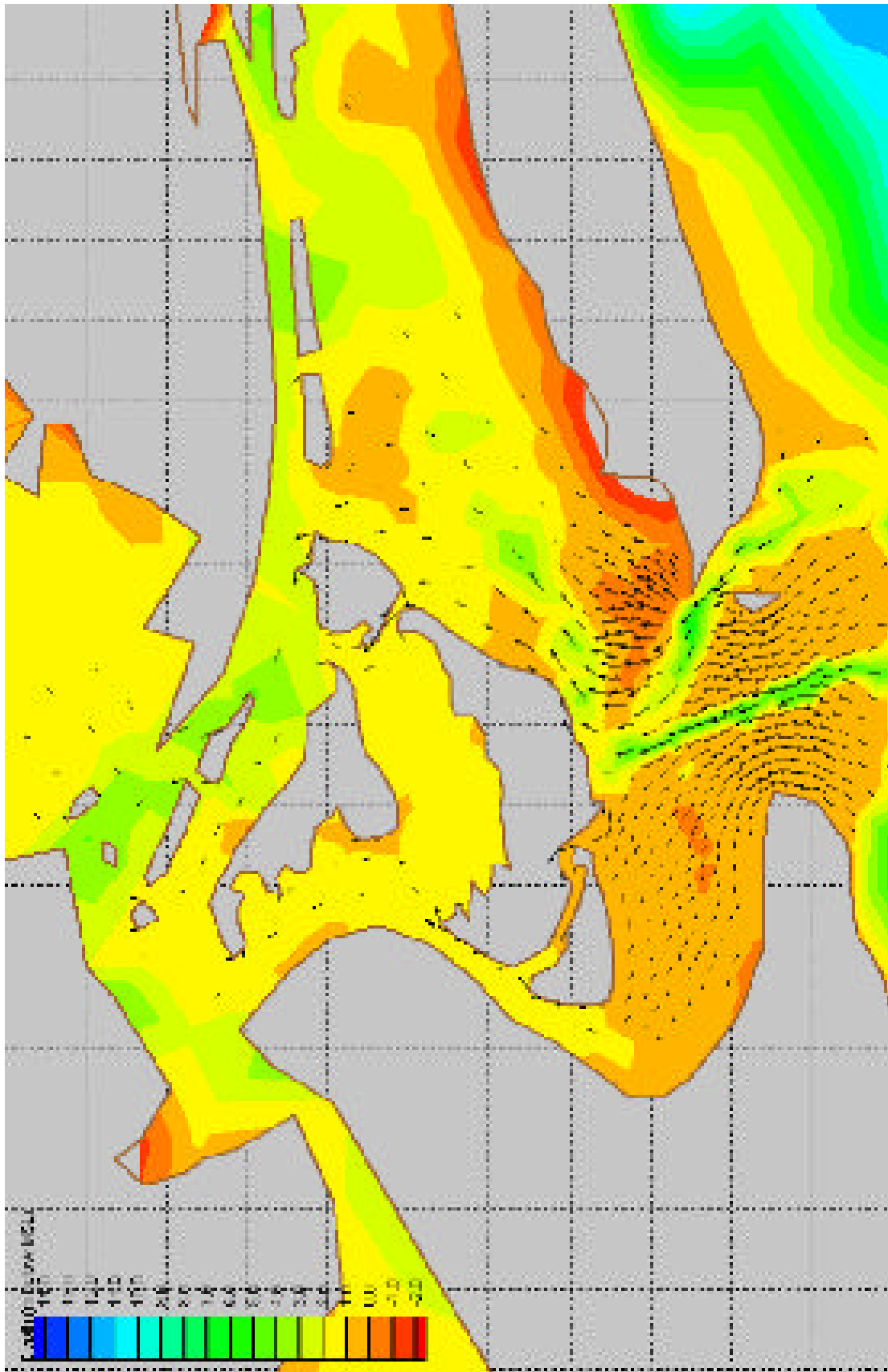
The concentration of flow near the south side of Dudley Island also remains. Average velocities across Transect 2 are 0.5 feet per second higher during peak flood and 0.7 feet per second higher during peak ebb.

Dredging a new channel while leaving the existing channel open also increases the tidal prism. Discharges through Transect 7 are 20 percent higher during flood and twice as high during ebb. However, changes in the flow regime are limited primarily to the new channel, the existing channel, and the south side of Dudley Island. In the remainder of the inlet and the adjoining basins, changes to the flow regime are negligible.

#### *-14 foot MLW Channel with Closure Dike*

To further reduce the flow in the existing channel, a +6 foot NGVD dike has been proposed to close the channel. The location of the dike is designed ensure its stability while under construction.

Preliminary simulations have shown that if sheet flow continues to occur across the Emerald Isle sand spit, strong flows in the existing channel will continue even with a dike in place. To eliminate this sheet flow, additional fill can be placed along the crest of the sand spit, raising its elevation to approximately +3 feet NGVD. The simulation appearing in Figure 7 assumes that this extra fill is in place.



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**BOGUE INLET, NC  
14' MLW CHANNEL  
PEAK FLOOD**

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FIGURE NO. 6A